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ABSTRACT

This paper deals with the question of how teacher attitudes emerge as teacher behaviors and the relationships between teacher attitudes toward mathematics, teaching, and students, and teacher behaviors as measured by external observers and pupils. Forty-nine ninth-grade mathematics teachers were the subject of this research. It was observed that the teachers who were more satisfied with teaching as a profession and who liked mathematics more were rated as being clearer, more varied in their presentations, more enthusiastic, more indirect, more likely to use higher cognitive questions, and less critical of students. The teachers who expressed less authoritarian views with respect to discipline and class control were rated as being less clear, as not providing as many chances for students to learn algebra, and as providing less emphasis on logic and analysis. The two sources for the ratings, observers and pupils, produced teacher behavior measures that related with different teacher attitudes. The observers' ratings correlated more with attitudes towards mathematics and teaching as a profession; the pupil ratings, more with teacher attitudes on class control. (Author/JD)

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RELATIONS BETWEEN TEACHER ATTITUDES AND TEACHER BEHAVIOR IN NINTH-GRADE ALGEBRA CLASSES

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RELATIONSHIPS BETWEEN TEACHER ATTITUDES AND TEACHER BEHAVIOR IN NINTH-GRADE ALGEBRA CLASSES

John W. McConnell

INTRODUCTION

Aiken's 1970 review of attitudes toward mathematics stated the common belief that "of all the factors affecting student attitudes toward mathematics, teacher attitudes are viewed as being of particular importance." (Aiken, 1970; p. 592). Aiken called for "more direct measures of teacher attitudes and their consequences (e.g., by teacher observation)..." (p. 590). Aiken's update on research in this area six years later was less assured: "The belief that teachers' attitudes affect students' attitudes toward mathematics has not been as easy to confirm as might be supposed." (Aiken, 1976; p. 299).

Kahn and Weiss's review on "The Teaching of Affective Responses" reported that for teaching in general"...very little direct evidence exists on the extent to which students' school-related affective behaviors are influenced by teachers' attitudes." (Kahn and Weiss, 1973; p. 774).

The Aiken reviews and the Kahn and Weiss chapter reported instances of research which failed to find significant correlations between teacher attitude measures and changes in pupil attitude. There may be a relationship, nevertheless, which is too subtle to be discerned through our current measures. To determine this relationship, it is necessary to hypothesize intervening constructs. A path of significant correlations through the measures of the chain of constructs would give some evidence that teacher attitudes do affect pupils. By asking what constructs would be hypothesized were the literature to report significant correlations, one can identify a critical question: how are the teacher attitudes communicated to the student? The logical link between the (internal) attitudes of the teacher and the (internal) attitudes of the student is the visible (external) behavior of the teacher.

Research which attempts to connect teacher attitude to pupil change must treat two questions. First, what teacher attitudes emerge as teacher behavior, and second, how do these teacher behaviors affect pupil learning and change in attitude?

A previous paper (McConnell, 1977) considered the latter question. Classroom behaviors of 47 ninth grade algebra teachers were measured through high-inference rating scales over a period of one year. Both pupils and external observers rated the teachers. Scales followed the Rosenshine-Furst (1971, 1973) constructs of teacher behaviors important for pupil learning. Other scales measured perceptions of cognitive emphasis.

Pupil learning and affect were measured via Y-population scales from the National Longitudinal Study of Mathematical Abilities (NLSMA). These scales conceptualized achievement and attitude as multidimensional. Classes were tested in Fall and Spring. Spring scores were adjusted via multiple regression to account for differences in initial standing. The resulting residuals were correlated with the teacher behavior measures to identify those categories of teacher behavior which were important for a class's change over the year.

This paper deals with the first question: How do teacher attitudes emerge as teacher behaviors? It reports on the relationships between teacher attitudes toward mathematics, teaching, and students, and teacher behaviors as measured by external observers and by the pupils.

DESIGN

MEASURES OF TEACHER BEHAVIOR

Observation Scales Used by External Observer

The researcher and a second observer visited the forty-seven teachers in the study four times during the year, twice each semester. Two low-inference behavior observation instruments were completed during thirty minutes of the observation period. Data from these instruments will be discussed in a forthcoming paper. At the end of the class period, the observer rated the teacher on the items developed by Ryans (1961). During the second semester, additional ratings were made on items developed from the Rosenshine-Furst review (1971) of process-product studies.

TCS Scales -- The volume Characteristics of Teachers (Ryans, 1961) published scales which had been tested and validated over large samples of elementary school classrooms. Twenty-two items from the final rating instruments were used in this study. Reliabilities and reduction to four factors were discussed in McConnell (1977). Table 1 summarizes the factors used in this study.

TABLE 1

IDENTIFICATION OF FACTORS IN THIS STUDY
WITH CHARACTERISTICS OF TEACHERS SCALES

	This Study		Characteristics of Teachers
TCSY	Responsible, Steady, Poised, Systematic vs. Evading, Erratic Excitable, Disorganized	Y 0	Responsible, systematic vs. Evading, Disorganized
TCSZ	Stimulating, Original, Alert, Broad vs. Dull, Stereotyped Apathetic, Narrow	Z 0	Stimulating, Original vs. Dull, Stereotyped
TCSX	Democratic, Kindly vs. Autocratic, Harsh	X 0	Responsible, Understanding, Kindly, Democratic, Optimistic vs. Aloof, Restricted, Harsh, Autocratic, Pessimistic
TCSC	Concrete, Practical vs. Abstract, Theoretical		(No comparative scale)

Process Rating Sheet -- A second rating scale was introduced for the last two observations. Following the Rosenshine-Furst review of process-product studies (1971), it had ten items to be rated on a 1 (low) to 5 (high) scale. No formal glossary such as that available for the TCS scales was used. It should be noted that one of the variables cited by Rosenshine and Furst does not appear on this sheet. That is "Student Opportunity to Learn Criterion Material." This variable was not an appropriate one for rating a class session.

The ratings on five of the items were high for most teachers despite the efforts of the observers to aim for a distribution of ratings centering on three.

The correlations between ratings on the third and fourth visits for the 43 classes on which full observations were completed are on Table 2. "Difficulty of Lesson" was notably unstable across the two visits. The other nine were adequately correlated.

TABLE 2

CORRELATIONS BETWEEN ITEM SCORES ON THE PROCESS RATING SHEET ON CLASS VISITS 3 and 4 for 43 CLASSES

	Item	r
PR1	Clarity	.382*
PR2	Variability	.375*
PR3	Enthusiasm	.636**
PR4	Business-like	.533**
PR5	Uses Student Ideas	.398**
PR6	Criticism	.565**
PR7	Structures Lesson	.347*
PR8	Higher Cognitive Questions	.595**
PR9	Probing Questions	.332*
PR10	Difficulty of Lesson	-.147

* $P < .01$

** $P < .05$

Observation Scales Used by Students

Classroom Activities Questionnaire -- The Classroom Activities Questionnaire (CAQ) provided a low inference rating sheet with which students could rate their teacher's emphasis on cognitive activites. Based on the Taxonomy of Educational Objectives (Bloom, 1956), it had been used in mathematics classrooms for gifted students (Steele, et. al., 1970) . It was used in this study to complement the Wright-Proctor observation scale, a low inference measure of cognitive emphasis.

The structure of the CAQ is indicated on Table 3. Further information on its development can be found in Steele, et al (1971). The CAQ was administered to 50% of the students in each class at the end of the first semester. Items were scored so that high schores implied more of the construct in the scale title with the exception of Test/Grade Stress and Lecture. These were weighted so that higher scores implied less Stress and Lecture, respectively.

TABLE 3

Scales from Class Activities Questionnaire With Definitions and Reliabilities Over 48 Classes

Identifier	Description
CAQM	Memory -- Recall and Recognition of Information (2 items, r = .31)
CAQT	Translation -- Paraphrasing or expressing information in different symbolic form (2 items, r = .30)
CAQI	Interpretation -- Recognition of relationships (2 items, r = .58)
CAQAP	Application -- Selection of appropriate methods and performance of operations required by problem situation (2 items, r = .46)
CAQAN	Analysis -- Recognition of structure of material, including conditio which affect the way it fits together (2 items, r = .66)
CAQSY	Synthesis -- Generation of new ideas and solutions (2 items, r =.28)
CAQEV	Evaluation -- Development and application of a set of standards for judging worth (2 items, r = .17)
CAQDS	Discussion -- Student opportunity for and involvement in discussion (2 items, r = .63)
CAQTS	Test/Grade Stress -- High pressure to produce teacher selected answers (High score: low stress) (2 items, r = .50)
CAQL	Lecture -- Teacher role as information giver with students in passiv listening role (High score: less time on lecture) (2 items, r = .58)
CAQLO	Low Cognitive Composite -- Memory, Translation, Interpretation (6 items, r = .11)
CAQHI	High Cognitive Composite -- Application, Analysis, Synthesis, Evaluation (8 items, r = .54)
CAQCF	Classroom Focus -- Discussion, Test/Grade Stress, Lecture (6 items, r = .34)
CAQCL	Classroom Climate -- Enthusiasm, Independence, Divergence, Humor, Teacher Talk, Homework (6 items, r = .61)

From: Steele, et al (1971, p. 451)

Classroom Process Questionnaire --

The teacher behavior constructs synthesized by Rosenshine and Furst (1971) were also measured through student ratings. Rosenshine provided the researcher with item sets he and his associates had been developing to produce class measures on ten areas of behavior. These were adapted for algebra classes. A twenty-five item scale was administered to 50% of the students in each class as part of the spring testing. The scales and sample items are on Table 4.

TABLE 4

CLASSROOM PROCESS QUESTIONNAIRE SAMPLE ITEMS

Identifier	Description and Example
RCLAR	Clarity (4 items; r=.80) "My teacher makes his points clear and easy to understand"
RQUEST	Questioning (1 item) "My teacher asks questions in such a way that you really have to think in order to answer them."
RVART	Variability (6 items; r=.63) "My teacher uses many different teaching methods."
RENTHUT	Enthusiasm (4 items; r=.74) "My teacher has high interest in teaching Mathematics
RDIFFT	Difficulty (3 items; r=.51) "My teacher spends too much time on easy problems."
RCRITT	Criticism (1 item) "My teacher spends too much time criticizing or finding fault with the students in this class."
RUSET	Use of Ideas (2 items; r=.87) "This teacher respects the ideas of his students."
RSTRUCT	Structuring (1 item) "This teacher gives a short summary at the end of the lesson."
ROPPT	Opportunity to Learn (1 item) "This teacher really doesn't give students many opportunities to learn the things they should be learning in Algebra."
RTASKT	Task Orientation (2 items; r=.31) "This teacher really makes you get down to work in class."

TEACHER OPINIONS ABOUT TEACHING

The instrument chosen to assess teacher attitudes was the Teacher Opinion Questionnaire of the National Longitudinal Study of Mathematical Abilities (Wilson, et al, 1968, pp 67-73). The inventory was intended by the NLSMA staff for use in assessing effects of teacher attitude on class achievement. The items originated in a Harvard University project which attempted to relate teacher attitudes to pupil achievement. The questionnaire went through several revisions and tryouts in the first two years of NLSMA. Wilson, et. al, (#9, 1968, pp 59-61) discuss the tryouts and revisions made during NLSMA years 1 and 2. In Spring, 1964, the questionnaire was mailed to 4940 teachers who had participated in the first or second year of the study. Approximately 3000 teachers returned the questionnaire. Later, in year 4 of NLSMA (Fall, 1965), the questionnaire was sent to 2370 teachers who had entered the study in year 3. Approximately 1330 were returned (Wilson, et.al., #9, 1968, p 60). More than 600 ninth-grade teachers completed enough of the questionnaire to be included in an item analysis. Since the researcher in this project knew he had a sample of teachers who were in communities of above-average economic standing, he felt that this questionnaire could offer a chance of investigating differences between his sample and the NLSMA stratified-random sample as well as measuring teacher attitudes which might affect student learning.

Considerable teacher anxiety was created by the items on the questionnaire. Some teachers ignored the questionnaire, some filled it out after a personal request was made, others wrote liberal comments by the items. Forty-three teachers returned the quesionnaire. Two teachers did not complete all items. Their scores on the items they did complete were used to project the scores they would receive had they completed all items. Since these two teachers left blank fewer than 20% of the items, their projected scores were determined to be accurate enough that the subjects (and their classes) could be included in the data analysis.

Seven scores were compiled from the Teacher Opinion Questionnaire. A description of each scale, number of items, and a representative item follow. They were adapted from Wilson, et. al. (1968, #9, pp 76-88). The items were generally six-option, strongly disagree to strongly agree type. Scoring of options used weights of 1 to 6 unless the item was negatively worded. Reverse scoring was then employed for such items and is indicated for negatively worded sample items.

Teacher Opinion Inventory Scales

TOI1 Theoretical Orientation -- This ten item scale was designed to measure appreciation of theoretical thinking, a belief in mathematics as a subject which can motivate people to its study, and appreciation for insight into mathematical relations rather than rote thinking.

> "If I went back to school, my first choice of a subject to study would be one concerning the foundations of mathematics."

TOI2 Concern for Students -- This eight item scale was intended to measure empathetic concern for the student's social and emotional development.

> "I don't think too much of recent trends among teachers toward a greater emphasis on the emotional problems of the student." (reverse scoring)

TOI3 Involvement in Teaching -- An eight item scale, ToI3 was designed to measure satisfaction with teaching as a profession.

> "There is no job which could possibly be as fascinating to me as teaching."

TOI4 Nonauthoritarian Orientation -- Higher scores on this six-item scale indicated a belief in a more democratic approach to working with students as opposed to strict discipline and class control.

> "Obedience and respect for authority are the most important virtues a child should learn." (scored reverse)

TOI05 Like vs. Dislike -- This 4 item scale contained three items which differed from the agree-disagree format of the others. Scoring is indicated for the sample item:

> "When I go to the library:(check the most appropriate statement)
>
> (4) I often take out a book on mathematics or arithmetic
>
> (3) If I happen to have heard about an interesting book on mathematics or arithmetic, I take it out to see what it has to say
>
> (2) Very rarely would I take out a book on mathematics or arithmetic
>
> (1) I can't remember when I have taken out a book on mathematics or arithmetic.

TOI06 Creative vs. Rote -- The ten items of this scale were designed to measure the belief that mathematics is a subject which contains relationships and facts requiring insight and creativity rather than facts to be learned by rote.

> "The emphasis in mathematics should be on accuracy." (reverse scored)

TOI07 Need for Approval -- The nine items on this scale were self-ratings which were socially acceptable but had a low probability of strong agreement or strong disagreement. If a teacher scored high on this scale, it is possible that his responses to items on other scales may have reflected his need for social approval rather than his actual beliefs.

> "My teaching brings out the best in every student"

(The extreme scores on TOI7 for this sample of 43 teachers indicated that none of the teachers had so high a "Need for Approval" that would distort their responses to other scales. This scale was therefore retained as a measure of attitude which would moderate teacher behavior.)

Table 5 shows the means and standard deviations associated with each TOI variable for this study. In addition, means and standard deviations are given for the NLSMA Y-Population grade 9 sample. Reliabilities in each case are internal consistency reliabilities. In only one case, TOI5 "Like vs. Dislike", did the reliabilities for this study fail to replicate the NLSMA data.

TABLE 5

MEANS STANDARD DEVIATIONS, AND RELIABILITIES FROM THE TEACHER OPINION INVENTORY ON THE SAMPLE OF 43 TEACHERS IN THIS STUDY AND 637 NINTH GRADE TEACHERS FROM THE NLSMA Y-POPULATION SAMPLE

Code	Scale	This Study			NLSMA[a]			Z-test
		Mean	SD	r[b]	Mean	SD	r[b]	
TOI1	Theoretical Orientation	39.25	5.93	.66	39.58	7.16	.69	-.30
TOI2	Concern for Students	34.16	5.35	.67	33.25	6.25	.69	.95
TOI3	Involvement In Teaching	31.67	5.29	.55	31.24	6.36	.67	.44
TOI4	Non-Authoritarian	23.37	4.47	.66	20.37	5.15	.63	3.82*
TOI5	Like vs. Dislike	14.23	1.02	.08	13.77	1.80	.57	1.68
TOI6	Creative vs. Rote	42.21	4.96	.47	43.64	6.62	.67	-1.42
TOI7	Need for Approval	37.27	5.02	.63	39.27	5.76	.72	-2.28*

a Wilson, Cohen, Begle, 1968
b Reliabilities (Cronbach Alpha)
* Significant at .05 level: $\bar{z}$ (.05) = 1.96

Two types of tests were conducted to test whether the teachers in this sample could be considered to be from a population comparable to that of the NLSMA study: a chi-square test of variances, and a Z-test for means.

The first test was a chi-square test (Johnson, 1976; p 333) to see if the variance of each scale was comparable to the variance of the population represented by the NLSMA Y-population teachers. For the seven scales, only two χ^2 fell outside the 95% confidence interval ($28.2 < \chi^2 < 58.1$). Those were for TOI5, "Like versus Dislike," ($\chi^2 = 13.5$), and TOI6, "Creative versus Rote" ($\chi^2 = 23.58$). TOI5 had a very low variance in this sample, as reflected in its low reliability for this sample. One problem with TOI5 was that only four items composed the scale, and these items had fewer options than the items for the other scales. The minimum score on TOI5 was 4; the maximum, 16. The average scores for both this sample and the NLSMA Y-population indicated that many teachers received top scores of 16. Since this scale did correlate with teacher behavior measures as reported later in this paper, it was retained despite its imperfections.*

The TOI6 scale, "Creative versus Rote," showed less variability than the NLSMA ninth grade teachers.

The second test in checking the representativeness of this sample of teachers was comparison of the means to the NLSMA means. The NLSMA results were assumed to define the population mean and standard deviation. A Z-test (Johnson, 1976; p. 262) was used to test whether the sample of teachers in this study could be assumed from the NLSMA grade nine population. The Z - tests are on Table 5.

Two scales had means significantly different from the NLSMA ninth grade means: TOI4, "Nonauthoritarian Orientation," and TOI7, "Need for Approval." The teachers in this sample scored higher on "Non-authoritarian Orientation" and lower on "Need for Approval."

The fourteen tests of variances and means produced the four significant statistics listed above. The majority of the tests, however, showed that this sample could have come from the population defined by the NLSMA grade nine data.

Table 6 gives the intercorrelations among the seven scales.

* The results by students (not by class) in Begle's (1972) analysis of the Y-population data indicated that TOI5 was a potential predictor of student achievement despite its lower reliability and range.

TABLE 6

INTERCORRELATIONS OF THE TEACHER INVENTORY SCALES

	TOI1	TOI2	TOI3	TOI4	TOI5	TOI6	TOI7
TOI1	1.00	.43**	.53**	-.13	.49**	.19	.48**
TOI2		1.00	.41**	.48**	.39**	.58**	.15
TOI3			1.00	.14	.34*	.35*	.30*
TOI4				1.00	.07	.52**	-.20
TOI5					1.00	.30*	.13
TOI6						1.00	-.19
TOI7							1.00

* Significant at the .05 level.
** Significant at the .01 level.

SAMPLE

Procedures for the selection of the sample were detailed in McConnell (1977). Forty-seven teachers in thirteen high schools from Chicago West and North suburbs offered one algebra class for the project. "Regular" or "average" algebra classes had been requested for this study. Complete observation data, complete student data, and complete teacher data were obtained for 43 of the classrooms.

ANALYSIS

The seven scales from the Teacher Opinion Inventory (TOI) were correlated with the nine measures of class change to see if any teacher attitudes were directly related to pupil learning and affect. Then the seven TOI scales were correlated with the thirty-eight measures of teacher behavior. One-tailed tests of significance were used since the TOI scales had been scored under the hypothesis that higher levles of the scales measured more beneficial behaviors. Although the number of significance tests was large, the use of multiple measures of teacher behavior minimized the chances of spurious results.

RESULTS

CORRELATIONS OF TEACHER ATTITUDES WITH PUPIL CHANGE

Some teacher attitudes did correlate with pupil achievement and attitude change. These are detailed on Table 7. Four of the seven scales related directly to pupil data. TOI3, "Involvement in Teaching" correlated .32 with the residual on the algebra achievement scale "Computation." TOI6, "Creative vs. Rote," correlated .32 with the residual on the attitude scale "Math - Fun vs. Dull." TOI4, "Non-authoritarian Orientation," and TOI5, "Like vs. Dislike," each correlated .28 with the residual on "Math vs. Nonmath."

The attitude scales TOI1, "Theoretical Orientation", TOI2, "Concern for Students," and TOI7, "Need for Approval," failed to correlate with any measures of pupil learning and affect.

TABLE 7

CORRELATIONS SIGNIFICANT AT .05 LEVEL BETWEEN PUPIL CHANGE CRITERIA AND TEACHER OPINION MEASURES FOR 43 CLASSES

Achievement Criterion*	Title	Teacher Attitude Scale	Title	R	Sig.
RESCOMPU	Computation	TOI3	Involvement in Teaching	.32	.02
RESCOMPR	Comprehension	None	----	--	--
RESANALY	Analysis	None	----	--	--
Attitude Criterion*	**Title**	**Teacher Attitude Scale**	**Title**	**R**	**Sig.**
RESFUN	Math Fun vs. Dull	TOI6	Creative vs. Rote	.32	.02
RESMATH	Math vs. Nonmath	TOI4	Nonauthoritarian Orientation	.28	.04
		TOI5	Like vs. Dislike	.28	.04
REASY	Math-Easy vs. Hard	None	----	--	--
RESFANX	Facilitating Anxiety	None	----	--	--
RESDEBX	Debilitating Anxiety	None	----	--	--
RESACT	Actual Math Self-Concept	None	----	--	--

* Residuals of Class Posttest Scores adjusted for Relevant Pretest Measures

CORRELATIONS OF TEACHER ATTITUDE MEASURES WITH TEACHER BEHAVIOR MEASURES

Table 8 presents the significant correlations between the seven TOI scales of teacher attitude and twenty-three of the teacher behavior measures. These are organized by categories of teacher behavior following Rosenshine and Furst (1971). Each category is represented by at least one measure produced by an external observer of the teacher's classroom behavior and one produced by the pupils. Each teacher behavior measure is assigned an importance number "IMPORT". This index indicates the number of criteria of pupil learning and affect the behavior measure correlated with, as reported in McConnell (1977).

Table 9 presents the correlations between the seven teacher attitude measures and the pupil ratings of cognitive levels in their classroom.

TABLE 8

CORRELATIONS BETWEEN TEACHER BEHAVIOR MEASURES AND TEACHER ATTITUDE MEASURES (SIGNIFICANT AT THE .05 LEVEL) GROUPED BY CATEGORIES OF TEACHER BEHAVIOR FOR 43 TEACHERS

Teacher Behavior Measure					Teacher Attitude Measure			
Category	Name	Description	Source	Import	TOI #	Title	r	Sig.
CLARITY	PR1	Clarity	Obs.	6[a]	1	Theoretical Orientation	.26	.047
					3	Involvement in Teaching	.44	.001
					5	Like vs. Dislike	.31	.023
	RCLART	Clarity	Pupils	6	4	Nonauthoritarian Orientation	-.26	.047
VARIETY/ VARIABILITY	PR2	Variability	Obs.	0	3	Involvement in Teaching	.33	.017
					5	Like vs. Dislike	.39	.005
					6	Creative vs. Rote	.28	.034
	RVART	Variability	Pupils	0	-	None	---	----
ENTHUSIASM	PR3	Enthusiasm	Obs.	0	2	Concern for Students	.34	.014
					3	Involvement in Teaching	.48	.001
					5	Like vs. Dislike	.26	.044
	TCSZ	Exciting-Stimulating	Obs.	6	2	Concern for Students	.30	.024
					3	Involvement in Teaching	.35	.011
					5	Like vs. Dislike	.34	.013
	RENTHUT	Enthusiasm	Pupils	5	3	Involvement in Teaching	.35	.010
BUSINESSLIKE/ TASK-ORIENTED	PR4	Businesslike	Obs.	4	3	Involvement in Teaching	.49	.001
					5	Like vs. Dislike	.33	.015
					6	Creative bvs. Rote	.27	.039
	TCSY	Responsible-Steady	Obs.	1	3	Involvement in Teaching	.39	.005
					6	Creative vs. Rote	.32	.018
	RTASKT	Task-Orientation	Pupils	6	-	None	---	----

TABLE 8 (Continued)

Category	Teacher Behavior Measure				Teacher Attitude Measure		r	Sig.
USE OF STUDENT IDEAS	PR5	Uses Student Ideas	Obs.	0	3	Involvement in Teaching	.31	.020
					5	Like vs. Dislike	.31	.022
					6	Creative vs. Rote	.29	.028
	RUSET	Use of Ideas	Pupils	0	-	None	---	----
CRITICISM	PR6	Criticism	Obs.	1	1	Theoretical Orientation	-.29	.031
					3	Involvement in Teaching	-.30	.025
					5	Like vs. Dislike	-.41	.003
					6	Creative vs. Rote	-.37	.007
	RCRITT	Criticism	Pupils	0	2	Concern for Students	-.28	.037
STRUCTURES LESSON	PR7	Structures Lesson	Obs.	1	3	Involvement in Teaching	.38	.008
	RSTRUCT	Structuring	Pupils	0	-	None	---	----
QUESTIONS	PR8	Higher Cognitive Questions	Obs.	3	3	Involvement in Teaching	.40	.004
					5	Like vs. Dislike	.35	.011
					6	Creative vs. Rote	.36	.010
	PR9	Probing	Obs.	1	-	None	---	----
	RQUEST	Questioning	Pupils	1	-	None	---	----
DIFFICULTY	PR10	Difficulty of Lesson	Obs.	0	-	None	---	----
	RDIFFT	Difficulty	Pupils	0	3	Involvement in Teaching	.28	.033
OTHER	TCSC	Concrete, Practical	Obs.	0	-	None	---	---
	TCSX	Democratic, Kindly	Obs	0	-	None	---	----
	ROPPT	Opportunity to Learn	Pupils	2	4	Nonauthoritarian Orientation	-.28	.035

[a] "Import" indicates the number of significant correlations which were achieved between the teacher behavior measure and the criteria of pupil learning and attitude change in McConnell (1977)

TABLE 9

CORRELATIONS BETWEEN MEASURES OF CLASSROOM COGNITIVE EMPHASIS AND TEACHER ATTITUDE SCALES SIGNIFICANT AT THE .05 LEVEL

Cognitive Scale	Import[a]	TOI1	TOI2	TOI3	TOI4	TOI5	TOI6	TOI7
CAQM	1	-.27						
CAQT	0							
CAQI	0	.33						
CAQAP	1	.29			-.30			.28
CAQAN	3				-.28			.28
CAQSY	0		.30					
CAQEV	0						-.30	
CAQDS	0			.26	.31			
CAQTS	0			-.26				
CAQL	2							
CAQLO	1				-.26			
CAQHI	0				-.32		-.29	.33
CAQCF	1				.32			
CAQCL	1			.26				

[a] "Import" indicates the number of significant correlations which were obtained between each CAQ scale and the criteria of pupil learning and attitude change in McConnell (1977)

Examination of tables 8 and 9 indicates that the significant correlations occurred more with observer ratings than pupil ratings. Table 10 summarizes the number of significant correlations for each scale. TOI3, "Involvement in Teaching," TOI5, "Like vs. Dislike", and TOI6, "Creative vs. Rote," were three scales which correlated more with the external observers' perceptions of teacher behavior than the pupils'. TOI4, "Nonauthoritarian Orientation," produced significant correlations only with pupil ratings of teacher behavior. TOI4 was also the attitude scale which produced the most surprising negative correlations with teacher behavior.

TABLE 10

NUMBER AND RELATIVE FREQUENCIES OF SIGNIFICANCE TESTS (.05 Level) FOR CORRELATIONS BETWEEN TEACHER ATTITUDE SCALES AND OBSERVATION SCALES

Teacher Attitude Scales	Behavior Measures		
	Source - Pupils (24)	Source-Observer (14)	Total (38)
TOI1	3 (13%)	2 (14%)	5 (13%
TOI2	2 (8%)	2 (14%)	4 (11%
TOI3	5 (21%)	10 (71%)	15 (39%
TOI4	8 (33%)	0 (0%)	8 (21%
TOI5	1 (4%)	7 (50%)	8 (21%
TOI6	2 (8%)	6 (43%)	8 (21%
TOI7	3 (13%)	0 (0%)	3 (8%

TEACHER BEHAVIOR AS THE LINK BETWEEN TEACHER ATTITUDES AND PUPIL OUTCOMES

The correlations reported in the previous two sections support the hypothesis that teacher behaviors are the means by which teacher attitudes are communicated to students and so affect pupil learning and attitude. The first section of results reported four significant correlations between teacher attitude scales and measures of class achievement and attitude. If teacher behaviors are a step in the path from teacher belief to student outcome, we should be able to illustrate this path with data from this study and from McConnell (1977). This is possible for each of the four significant direct correlations.

Each criterion variable is illustrated in a separate figure. Teacher behaviors are listed only if they serve as a connector between a teacher attitude and pupil outcome.

Computation

The pupil achievement variable Computation correlated with the teacher attitude scale TOI3, "Involvement in Teaching." The behavior variables which served as the intermediaries were the two observer produced ratings of task-orientation, PR4 and TCSY. The relationships are illustrated in Figure 1

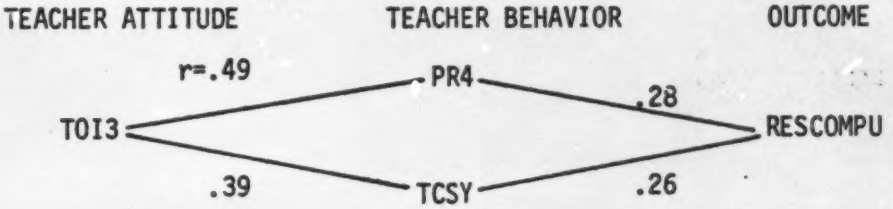

Figure 1.

Math-Fun vs. Dull

The attitude scale "Math-Fun versus Dull" had residuals which correlated with the teacher attitude scale TOI6, "Creative vs. Rote." Two teacher behavior measures serve as intermediaries. Both are produced by an observer: PR4, "Business-like", and PR8, "Higher Cognitive Questions." Relationships are detailed in Figure 2.

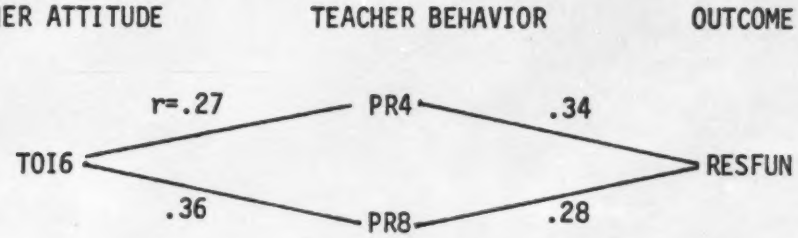

Figure 2.

Math vs. Nonmath

Two teacher attitude scales correlated with the residual class attitudes on the attitude scale "Math vs. NonMath". These were TOI4, "Non-Authoritarian Orientation," and TOI5, "Like vs. Dislike." The intermediary for TOI4 appeared to be the pupil rating of class emphasis on Analysis, CAQAN. TOI4 correlated negatively with CAQAN, which in turn correlated negatively with RESMATH and accounted for the positive correlation between TOI4 and RESMATH. Less authoritarian orientation was associated with less emphasis on analysis, which was associated with the class favoring math over nonmath courses. A contradictory connection was present via RCLART, pupil rating of teacher clarity.

TOI5 related to four observer ratings of teacher behavior connected with attitudes on the "Math vs. Nonmath" scale. These were PR1, "Clarity", PR4, "Businesslike", and PR1, "Higher Cognitive Questions." These relations are diagrammed in Figure 3.

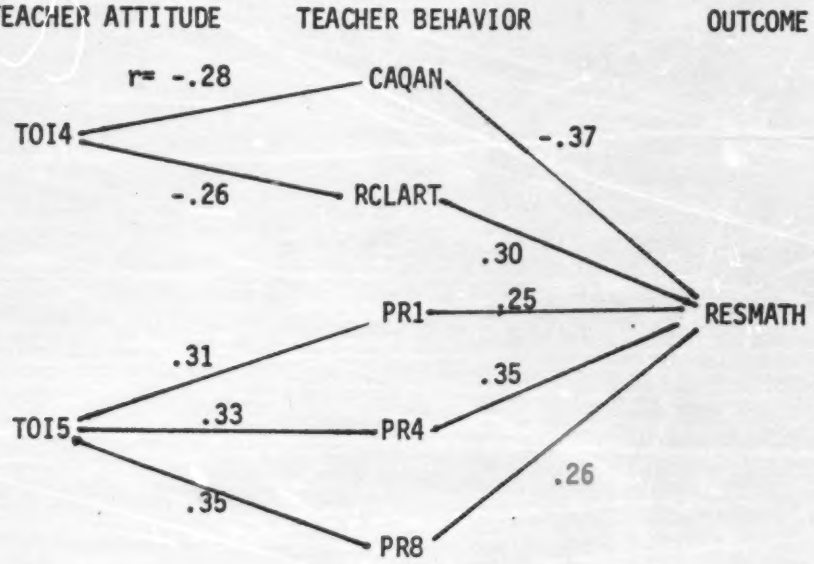

Figure 3.

DISCUSSION

This study has shown that teacher attitudes are related to behavior patterns which are discernible by observers. The teachers who were more satisfied with teaching as a profession and who liked their subject more (in this case, mathematics) were rated as being clearer, more varied in presentations, more enthusiastic, more task-oriented, more indirect in the sense of using student ideas, more apt to ask higher cognitive questions, and less critical of students. The teachers who were more opposed to strict discipline and class control were viewed as being less clear, not providing as many chances for students to learn algebra, and providing less emphasis on logic and analysis.

These results, taken in conjunction with the effects of teacher behavior on pupil outcomes as reported in McConnell (1977), indicate that teacher attitudes do surface in the teacher's classroom behavior. The teacher behavior in turn affects pupil learning and attitude. The previous study had shown that teachers rated as clearer, more enthusiastic, and more task-oriented provided classes with more positive attitudes towards mathematics. The more task-oriented teachers produced classes with better computation skills; the clearer teachers produced classes which did better on analysis problems. On the other hand, teachers who spent more time on logic and analysis had classes which developed more negative attitudes toward mathematics. With the exception of teacher talk, each of these important teacher behaviors correlated with teacher attitudes as reflected by the Teacher Opinion Questionnaire. Teachers who liked mathematics more, who were deeply involved in teaching, and who were oriented towards the creative aspects of mathematics were clearer, more enthusiastic, and more task-oriented. Teacher views towards discipline and class control were not clearly placed in the chain leading to pupil change, however. On the one hand, less authoritarian teachers were rated by their pupils as spending less time on logic and analysis. This was good in the sense that less class time in this cognitive area was associated with more positive student attitudes. On the other hand, less authoritarian teachers were rated as less clear and less able to provide opportunities to learn. It may be that these results are consistent in that the less authoritarian teachers are providing less instruction in all areas. It is difficult to generalize this to a larger population of mathematics teachers because the teachers in this sample were significantly less authoritarian than the NLSMA Y-Population teachers.

Although this study was limited to algebra classes in thirteen suburban high schools, the results have implications beyond mathematics. The teacher attitudes found to be important in mathematics classes have analogues in other subject areas. The teacher behaviors which were affected by teacher attitudes were, for the most part, not unique to algebra teaching.

The results present a challenge to teacher educators and supervisors of teachers. The improvement of teaching via the modification of a teacher's instructional behavior may be limited by the teacher's attitudes. A teacher training institution may avoid this limitation by selecting its students on the basis of evidence of positive attitude. A supervisor in the schools does not have this option. He/she needs creative (and legal) means for improving teacher attitude.

Further research in the area of effects of teacher attitudes must include measures of teacher behavior. This research has shown that teacher behavior is the vehicle through which teacher attitudes influence students. The multiple measurement of different attitudes, different behaviors, and different outcomes has been shown through this study to be necessary for our understanding of the complex interrelationships of attitudes and behavior in the classroom.

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